THE AUSTRALIAN BUSHLIGHT PROJECT:

SUSTAINABLE ENERGY SERVICES IN REMOTE AUSTRALIA.

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ABSTRACT

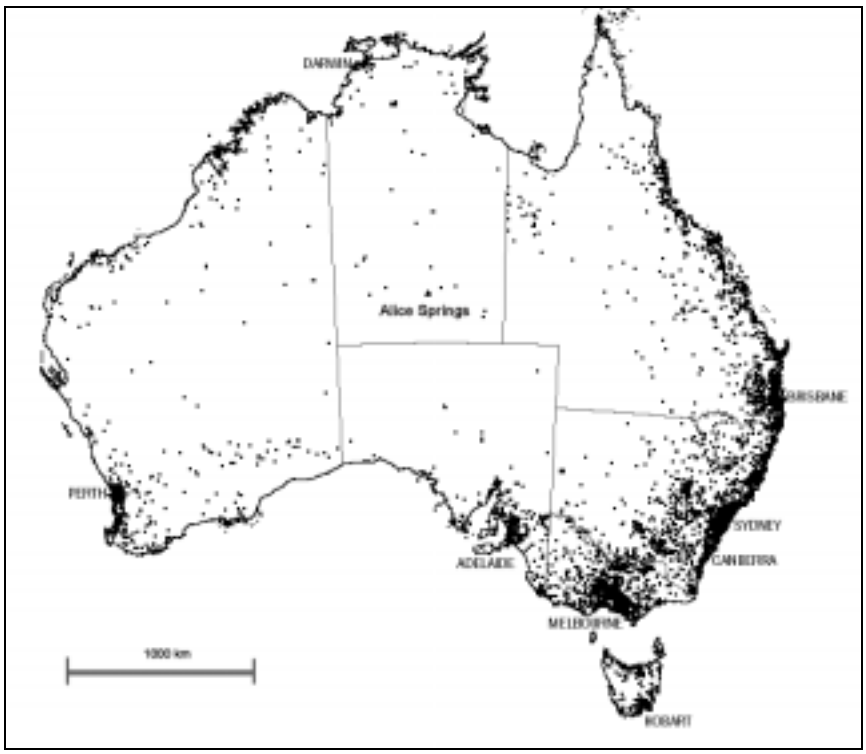
The paper reports on the findings of a market survey of renewable energy (RE) installations throughout remote Australia and the community support project initiated to address the findings of the survey. The survey visited small Indigenous communities powered by renewable energy and examined the perceptions of people using these energy sources. A lack of information, high up front costs, a shortage of trained personnel, lack of regular maintenance and distance to service centres were all identified as barriers to successful deployment of RE and all contributed to negative market perceptions.

The challenges identified in the survey have been addressed through a national strategy to shift industry practice away from delivering "off the shelf" technology to a process of facilitating access to remote energy services. The paper describes the 'Bushlight' project developed to provide renewable energy services to Indigenous communities throughout the remote outback of Australia.

BACKGROUND

Australia's population is highly urbanised. In 1991, 85 per cent of Australians lived in settlements with populations of 10,000 or more. The remaining 15 per cent live in small country towns, on farms or in remote settlements. Australia's largest settlements occupy less than one per cent of the nation's land area and are home for two thirds of the Australian population.[i]

The map illustrates the unique distribution of Australians with almost 94 per cent of the Australian population living within 100 kilometres of the Australian coastline.



Distribution of the Australian population (Australian Bureau of Statistics, 2002)[ii]

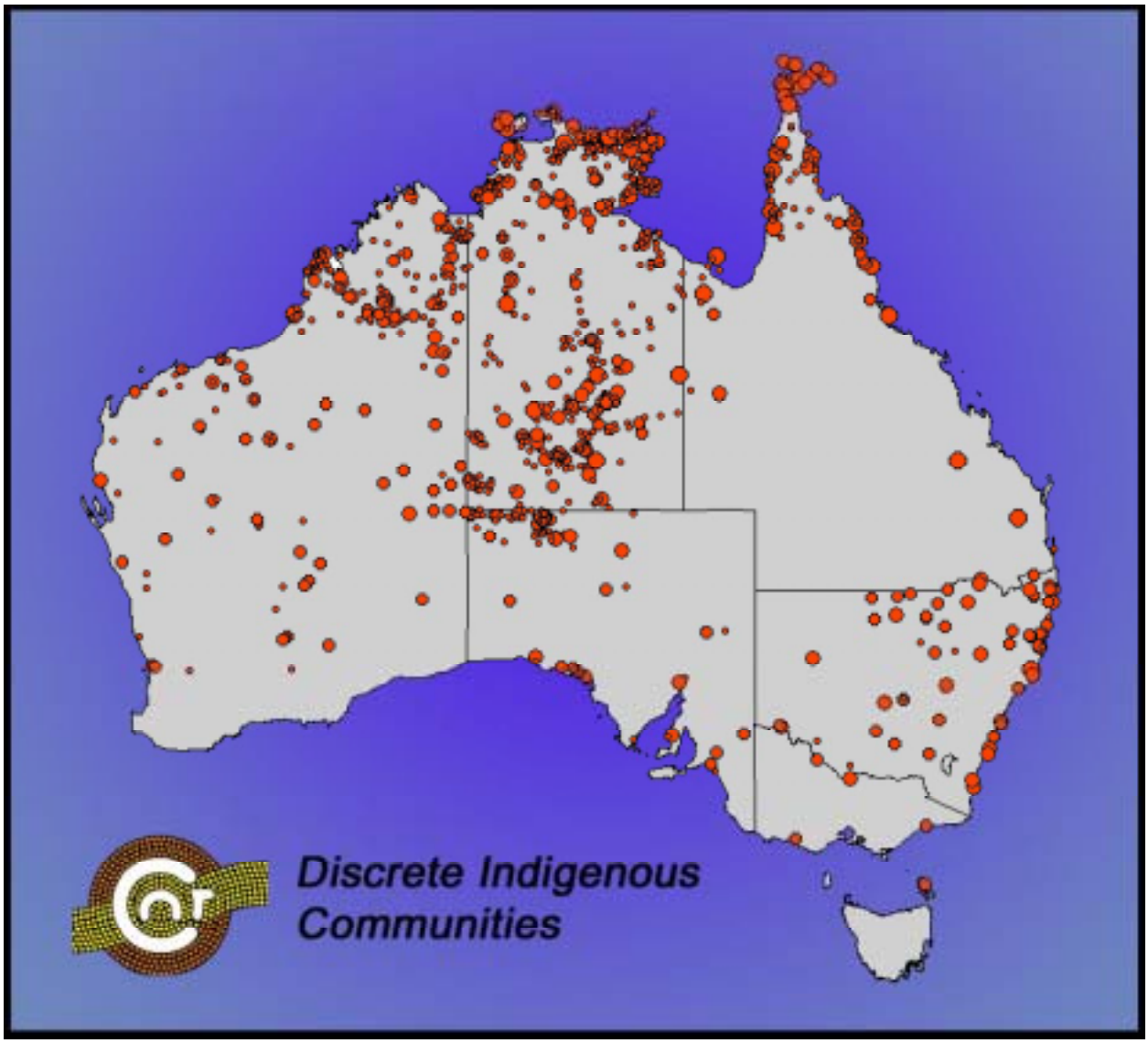
While over 85% of Australia's population resides in major coastal centres, the remote regions of Australia are used for agriculture, mining and tourism, and are home to many of Australia's Indigenous people. The provision of electrical energy over such vast areas presents unique challenges, some of which are socio-economic, and usually falls back to small individual systems for communities, homesteads and mine sites. Renewable energy has traditionally been seen as an economic option in such areas, however, little was known about the aspirations and attitudes of people in this market. A market survey of renewable energy applications in remote Australia was undertaken between 1998 - 2000 by the Centre for Appropriate Technology (CAT) in Alice Springs as a commitment to the research effort of the Australian Cooperative Research Centre for Renewable Energy (ACRE) [iii].

The work provided one of the most extensive field market surveys detailing the use of renewable energy (RE) systems in remote area power supplies (RAPS) in Australia. The survey team visited 134 separate remote sites examining over 350 separate power and water pumping systems. Householders' were questioned to ascertain their attitudes to renewable energy. Installation and maintenance people were interviewed and 1270 survey forms were mailed-out. The amount of data collected was prodigious.

The market survey focussed on communities and households further than 50km from a main service town or supply centre. Telecommunication installations and mining centres were not included in the market survey.

Map showing main site visits.

INDIGENOUS COMMUNITIES



Over the last thirty years, there has been a significant movement of Indigenous people back to traditional country, setting up small communities; often described as outstations or homelands. Outstations provide people with closer links to country and are usually organised in family groups. The populations of outstation communities tend to be small, often less than 50 people. Most are located in remote regions of the Northern Territory, Western Australia, South Australia and Queensland.

The location of these communities means they are generally beyond the present limits of municipal services and infrastructure. The nearest major centre may be several hundred kilometres away. The Community Housing & Infrastructure Needs Survey (CHINS) completed in 1999 revealed that people had to travel an average of 2.25 hours to reach their nearest main centre. Communities can be isolated for extended periods, as access roads become impassable at certain times. In general inaccessibility stems from seasonal factors (i.e. the wet season) combined with roads of a marginal quality. The remoteness of these communities has implications for access to technical support services and access to spare parts for equipment. Reliability becomes a high priority under such circumstances.

Generally an outstation will have close ties to a nearby large community, where people can access a store, school, health clinic and other services. Outstation infrastructure such as housing, power and water supplies will often be the responsibility of a local resource agency or the Community Council. People move regularly between outstations and the larger community or regional centre. This movement could be for any of a number of reasons including restocking provisions, catching up with family or attending a cultural or sporting event. High mobility impacts on the stability and permanency of a community. Populations can fluctuate significantly from week to week.

Many outstations are located at significant Indigenous sites. For cultural or social reasons there will be periods throughout the year where people need to be at these sites - although they will not necessarily be intended for long-term living. There are also sites, which, although they are considered home by Indigenous people, are unable to be occupied year round due to flooding, lack of access or seasonal water supplies.

The number of remote Indigenous communities in Australia has grown over the last 30 years. There are now approximately 110,000 Aboriginal people living in 1216 discrete communities with an average size of 107 people.

A total Indigenous population of 370,000 represents just under 2% of the Australian population but nearly 20% of Australia's remote population. One third of Indigenous people live in discrete Indigenous communities, the remaining number live in cities and large urban localities.

Community Size	0 to 20	21 to 50	51 to 100	101 to 200	Over 200	Total
No of Communities	616	273	102	80	145	1,216
Total Population	5,085	8,004	6,728	11,034	77,234	108,085
Percentage of Population	4.7%	7.4%	6.2%	10.2%	71.5%	100%

Of the recorded 1216 communities, 889 had fewer than 50 people in them (73% of all Indigenous communities have less than 50 people). Conversely 71% of those Indigenous people living in discrete non urban communities are in communities of greater than 200 people. These figures vary widely across the States and Territory.

A total of 17,000 permanent dwellings were reported as being located in the 1,216 communities described above.

The small size and high levels of mobility in many of these regional communities, combined with a lack of access to specialised services, low levels of technical training and formal skills and small community budgets, make provision of services extremely challenging. In general these people suffer severe socio-economic disadvantage, high unemployment, reduced life expectancy and have chronic disease patterns.

INDIGENOUS EXPERIENCE WITH RENEWABLE ENERGY

A total of 88 Indigenous communities were visited during the RE market survey. Typically the sites surveyed were small outstations consisting of between one and five houses; perhaps with a workshop and almost always with a bore water supply. The average number of inhabitants was 14 within a range from 3 to around 50. The sites were remote: the average distance to a regional centre was 280 km (70 km to nearly 1000 km).

The total installed PV systems surveyed was over 243 kW coming from nearly 3400 panels. The average number of panels per house (for PV powered houses) was 8 giving around 0.63 kWp per house. A total of 2201 batteries were examined. In terms of battery types it was found that 67% of systems used flooded cells and 33% sealed, valve-regulated cells. Nine communities surveyed had a wind component as part of the renewable energy system and two communities had a diesel/battery system with no renewables.

The age of the renewable energy systems surveyed ranged from around 10 years to brand new. In many cases, however, it was not possible to accurately date the age of the systems. The survey showed that a little under two thirds (64%) of the RE systems were operational at the time of visit. The percentage was about the same as that for small petrol engine generators (67%) and somewhat worse than for small diesel powered generators (79%). The situation for solar powered bores was much better with nearly 90% of systems operational at the time of the survey.

Analysis of the system faults at the time of the visit revealed that 28% of the sites experienced battery problems, 16% had inverter problems, 15% had control system difficulties and 22% of systems had other (determined) failures.

No discernable difference was found between wet cell batteries and sealed, valve regulated cell batteries in terms of reliability. It was found that some 61% of sites (including sites which had RE systems operating at the time of the visit) had experienced recent problems with the renewable component of the system. Only 9% of sites had experienced problems due to vandalism or theft.

Respondents at 40% of sites were happy with their renewable energy system. Complaints were heard that insufficient power was available at 36% of sites and there were suggestions of recurrent problems at 43% of sites. At 35% of sites respondents suggested that the maintenance situation was not satisfactory. It was noted on this latter point that only 26% of the systems were under some form of maintenance contract. Local persons were trained in the care of the system in only 8% of cases.

It was clear that Indigenous communities generally placed a higher priority on function than on any intrinsic benefit of using renewable energy. Overloading of the systems was found to be common due to frequent population changes within households and higher expectations once systems were installed. In general, awareness of energy conservation as a reason for having a renewable energy system was low in Indigenous communities with only 2% of householders suggesting that energy conservation was important. Similar numbers (2%) thought that environmental issues were important in choosing the type of system.

MARKET SURVEY FINDINGS

A major conclusion from the data collected is that renewable energy systems are not maintenance-free. Maintenance is mainly needed for the balance of system components and includes regular servicing and storage battery replacement. Costs for such maintenance are strongly related to the distance of the system from the nearest service centre. Lack of regular maintenance support for RE systems is thought to be one of the major issues to be tackled to obtain a viable RE product in remote areas.

In general the smaller (less than 5 kW) renewable energy systems tended to be both more reliable and better received by the market than larger systems. RE powered water supply systems (mainly solar bores) fared much better in terms of reliability than RE electricity supply systems.

The demand for energy efficient appliances was not significant, probably because in most cases the subsidised cost of electrical power in remote Australia meant that the real cost of generation is not reflected in the consumer's electricity tariff.

Indigenous communities stressed reliability and education and training as vital to the success of RE systems in remote areas, however, good on-the-ground examples of successful training packages were not apparent. Existing warranties for RE systems were not found to be consistently honoured. Some method of implementing a system of warranties that would be both fair to the consumer and to the supplier was thought highly desirable. Demonstration systems were generally not thought to be the best way of transferring technology with people resenting being used as test sites for technology that was often in the process of development.

In the context of remote communities reliability is generally more important than efficiency, and proven technology is more highly regarded than demonstration technology. Within the Australian industry there is a great deal of custom design work by small companies working on small margins with a limited capacity to offer realistic warranties and service backup across vast areas of Australia. This component of the energy supply network has an important impact on system performance.

The one point that was obvious from the study was that transport costs tended to dominate overall system economics in remote areas of Australia.

Failures in the electronic control systems and inverters tended to dominate recurrent maintenance problems while battery failures were found to be the most common final reason for system failure. Although around two thirds of systems had wet cell batteries, the failure rate for wet cells and sealed, valve-regulated cells were approximately equal. The observed electronic control/inverter systems tended to have high component counts, often in several discrete boxes from different original manufacturers. The great number of different systems that were observed during the field studies was found to lead to a low level of both operator and maintenance technician familiarity. For the larger systems, maintenance and problem solving had to be referred to the original manufacturer or a regional supplier. The conclusion from this plethora of electronic options is that there is a need to produce standardised, reliable, user-friendly designs.

CHALLENGES TO INCREASING USE OF RENEWABLE ENERGY

Although many smaller communities have adopted RE systems there is a perception that commercial systems, while offering the potential for cheap power, are not sufficiently reliable in the physical and social environments which characterise remote communities.

- Technologically complex elements of systems are prone to breakdown, with parts often being expensive to replace, and difficult to obtain in remote areas. These problems are compounded by a relative lack of standardisation across commercially available systems;

- Many systems do not generate sufficient power to cope with peaks in demand and, without other support or advice, communities either experience frequent power outages or overly rely on diesel back-up systems;

- In the absence of technical advice communities may purchase renewable energy systems for their total power needs when these might be better met by a mix of smaller supply systems tailored to different power uses, including greater use of small-scale direct-current (DC) supplies and energy efficient appliances.

These issues have the potential to substantially limit the expanded use of RE, particularly by larger communities. There are seven key challenges to meet if use of RE is to be sustained.

High capital cost of RE:
Innovative schemes are needed to finance capital costs. The Australian Greenhouse Office and the Department of Industry, Science and Resources are currently progressing this challenge with a series of industry and consumer initiatives[iv] .

Increase reliability of RE in remote locations:
There is a need for product innovation focussed on reducing component count, developing "standard" systems, increased use of third party, accredited testing laboratories and improved quality control during manufacture. Feedback to industry is also needed to highlight product deficiencies. The development of standard systems should lead to increased production volumes and hence decreased production costs.

Provide effective trained personnel to maintain and service RE systems:
There is a need for improved education programs and improved accreditation of installers for remote areas.

Improve back up for RE systems in remote areas (especially Indigenous communities):
There is a need to establish a dedicated service for Indigenous communities. Flow on could then be expected to other sectors.

Manage information regarding RE capabilities and availability:
There is a need to establish a national clearinghouse and database. Particular emphasis should be given to distributing information on reliability.

Address demand management problems:
There is a need for consumer education on demand management, development and manufacture of high efficiency end use devices, electronic control solutions for managing demand and looking at demand management and household energy use as a whole.

Overcome the mismatch in perceptions between the industry and the market: There is a need to continue objective market research and to keep a close watch on consumer attitudes, in particular to emphasise reliable first hand information.

THE AUSTRALIAN 'BUSHLIGHT' PROGRAM

The Australian government has introduced a program of renewable remote power generation (RRPGP) to offset the high capital cost of renewable energy systems in remote areas. The Australian Greenhouse Office (AGO) and the Aboriginal and Torres Strait Islander Commission (ATSIC) have responded to the market survey outlined in this paper and have complemented the RRPGP capital program with an Indigenous community support program. This program, known as Bushlight, has a vision of bringing light and life to the Australian bush.

The goal of Bushlight is to improve the livelihood choices for Indigenous people. Bushlight will meet this goal by increasing the access of remote communities to sustainable (affordable, consistent and reliable) renewable energy services. The

project adopts an holistic full service delivery model where there is a clear shift from an emphasis on the development and transfer of RE technology to the provision of access to energy services that meet the needs of people.

The project is being managed by a joint venture of the Centre for Appropriate Technology (CAT) and the Australian Centre for Renewable Energy (ACRE). The total project is worth $24 million Australian dollars and it is important to note that one third of the project funds are directed at the community support component of the project.

The project aims to develop energy services in up to 200 communities across mostly northern Australia over the next four years. Most of these communities will have populations of less than 50 people. The project will deliver modular systems with integrated services and provide for regional service backup, training and community capacity building.

There are four Bushlight project components.

1 Bushlight Operations.

This component establishes and manages an effective business organization which has 4 offices through out the north of Australia and a research facility in Perth.

2 Improved Renewable Energy Systems

Research and development work conducted by ACRE will improve reliability and cost effectiveness of RE systems in targeted communities. This component addresses issues of quality control, design issues, component and system testing in the ACRELab facility and technical elements of the tender and procurement process. It includes a significant database of operational performance of systems. A range of RE systems from small stand alone household models to diesel hybrids will be developed. ACRE works with industry to ensure they are consulted and understand the project goals.

Key design features are:

- Simplicity in design, configuration and operation through less complexity and low component counts with limited automation of genset operation, thereby reducing risk of failure
- Supporting and encouraging community interaction and energy awareness through user friendly interfaces and display panels inside the house.
- Individual household systems tied to family ownership.
- Ease of maintenance including standardisation of components, consistent equipment layout, plug and play components (eg inverter and charge controllers)
- Inclusion of demand side management into energy service package covering essential and discretionary loads, DC lighting and some DC or energy efficient AC appliances.
- Monitoring for fault finding and maintenance including a mix of onsite and remote datalogging and data management for timely support.

Quality assurance and testing features includes:

- Pre testing of components and systems including eligible inverter, charge controllers and DC appliances, PV panels and batteries through ACRELab.
- Tests focussed on durability in both tropical and desert environments, reliability and serviceability with non specialised tools, and performance to specifications and electrical safety requirements.
- Suppliers and installers pre-qualified and accredited through expression of interest and tender process.

Remote system monitoring and data collection to facilitates:

- Prediction of maintenance requirements and increase technical reliability.
- Centralised data collection and information management systems to manage technical and non-technical community information
- Decentralised web based access to centralised database.

3 Shared Services.

This component addresses community education and information services and capacity building in service delivery. Field staff work intensively with communities to understand energy needs and provide advice on energy systems. Discussions range across peoples ability to pay for services, tariff structures and issues of ownership of energy services. They also include demand side management options and the creation of a community sinking fund to allow communities to replace batteries and appliances when they reach the end of their service life. The discussions culminate in the development of a community energy plan. The energy plan provides the basis for a service agreement between Bushlight and the community once the RE system is installed.

The capacity building begins before installation of systems and extends beyond the transfer of the technology. Bushlight establishes regional energy service networks that provide service and training to community members. The networks ensure people know where spare parts can be obtained and advice is available where people choose to upgrade their systems. There is a program to monitor the performance of energy services and feedback into the design component of the project.

A third sub-component of shared services is to work with communities to enhance livelihood options as a result of improved access to energy services. This area looks specifically at the new opportunities that arise as a result of having available energy, particularly in the area of telecommunications and digital futures.

4 Capital Works

This component ensures that the energy plans of communities are realised with the installation of RE systems according to an annual plan of works. The procurement of systems in batch purchases and the management of suppliers and installers occurs in this part of the project.

CONCLUSION

The Bushlight project has been running for 6 months and has recently called its first round of tenders for supply of systems. It is a complex and exciting program whose success depends as much on its ability to build the capacity and confidence of

individuals, communities and industry as it does on technical excellence of RE technology.

It represents a clear shift in emphasis from the development of RE technology to the provision of energy services that meet the needs of people. Bushlight provides the opportunity for Australia to better understand this shift and develop a service industry built around renewable energy services.

[i] Commonwealth of Australia, *"Australia: State of the Environment 1996*, CSIRO Publishing, 1996.

[ii] Australian Bureau of Statistics (2002b). Regional Population Growth, Australia and New Zealand (ABS Cat. No. 3218.0). Australian Bureau of Statistics, Canberra.

[iii] Lloyd B, Lowe D, Wilson L, "*Renewable Energy in Remote Australian Communities (A Market Survey)",* Australian CRC for Renewable Energy Ltd, Perth, Australia 2000. The report is in three parts, Executive Summary, Final Report and Case Studies. The Australian CRC for Renewable Energy is based at Murdoch University, Perth, Western Australia. (http://acre.murdoch.edu.au) The authors worked for CAT.

[iv] *"*The Commonwealth Government recognises that renewable energy will be an important feature of Australia's response to the Kyoto Protocol and Australia leads the world in its support for renewable energy as a way of reducing greenhouse gas emissions. In this regard, the Government has instituted a range of targeted programmes and initiatives costing around $380m over four years to promote the development and use of renewable energy. These include:

- requirement that 9500 GWh (or around 2%) of Australia's energy supply be sourced from renewable energy by 2010;
- Remote Renewable Power Generation Programme;
- Photovoltaic Rebate Programme;
- Renewable Energy Showcase Programme;
- Renewable Energy Commercialisation Programme;
- Renewable Energy Equity Fund; and
- Renewable Energy Action Agenda.

Eligible renewable energy initiatives will also be able to seek support under the four-year, $400m Greenhouse Gas Abatement Programme*."*